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TIROS SATELLITE PAYLOAD

Today's launch from the Atlantic Missile Range will attempt to place a 270-pound meteorological satellite into a circular orbit, approximately 400 miles above the Earth. Primary satellite instrumentation consists of two TV cameras to take still photographs of the Earth's cloud cover. Launching vehicle will be a Thor-Able rocket.

The satellite looks like a giant pillbox, 42 inches in diameter and 19 inches high. Its appearance is somewhat unusual since its top and sides are almost completely covered by banks of solar cells -- over 9000 in all. Extending beneath the payload are four transmitting antennas. A single receiving antenna is located on the top.

Orbital inclination will be about 50 degrees to the equator. Traveling about 18,000 mph, the satellite will circle the Earth on an average of once every hour and one-half. The belt covered by the orbiting TIROS will extend from 50° N. Latitude to 50° S. Latitude. In the Western Hemisphere this covers an area between Montreal, Canada, and Santa Cruz, Argentina. During its approximately 1300 orbits during the next three month, TIROS will sweep over every point in this belt.

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The payload is named TIROS (Television and Infra-Red Observation Satellite). There are two TIROS satellites scheduled this calendar year; however, this first is not equipped with the infra-red radiation sensors which map relative temperatures of the Earth's surface.

This U. S. launching is part of a long-range program designed to develop a satellite capability for providing world-wide meteorological information. The ultimate goal of the weatherman is to have world-wide meteorological observations at his finger tips for analysis. This would greatly assist him in preparing his weather forecasts. Such a wealth of data would lead to a more complete understanding of our weather and with this, perhaps some theories relating to weather control.

There are specific reasons for photographing cloud cover. Such pictures will provide meteorologists with cloud patterns indicating birth or existence of hurricanes, cyclones and other weather activity. It is hoped that these photos will provide meteorologists with more detailed information on individual cloud types over specific areas. Analysis of this data will assist meteorologists toward a better understanding of the causes of our weather.

The TIROS satellite is an <u>experiment</u> -- in itself it cannot be considered an operational weather system. Its useful lifetime is expected to be only about three months. However, if a meteorological satellite relaying weather data to Earth proves feasible, such a system consisting of several satellites providing coverage over the entire globe may one day be used on a continuing 24-hour basis.

This TIROS satellite, in addition to its TV cameras and associated equipment, contains beacon transmitters, attitude sensors, and telemetry circuits. Power is supplied by nickel-cadmium batteries charged by solar cells. Power output is expected to average about 19 watts.

There are two primary ground stations which can both command the satellite and receive photo data. These are located at Ft. Monmouth, N. J., and Kaena Point, Hawaii.

The two TIROS TV cameras differ in coverage and resolution. The side-angle camera, at 400 miles altitude, is designed to cover an area of cloud cover roughly 800 miles on a side. The narrow-angle camera will photograph a smaller area located within the wide-angle camera's view.

Identical except for lens equipment, the cameras are both the size of a water glass and use a ½-inch Vidicon tube especially designed for satellite use. Each camera consists of two parts: a Vidicon and a focal plane shutter which permits still pictures to be stored on the tube screen. An electron beam converts this stored picture into a TV-type electronic signal which can be transmitted to ground receivers.

These are some of the characteristics of the cameras--lens speed: wide angle - f/1.5, narrow angle - f/1.8; shutter speed: 1.5 millisec; lines per frame: 500; frames per second 1/2; video bandwidth: 62.5 kc.

Connected to each camera is a magnetic tape recorder. Out of ground station range, TIROS can record up to 32 photographs on the storage tape for later relay. Or, picture data from the cameras can by-pass the tape and be transmitted directly to the ground when within range of a station. The Mylar-base tape is 400 feet long and moves 50 inches per second during recording and playback. The two TV systems and their associated equipment operate independently of one another.

Photo data are transmitted from one camera at a time. Tape readout from each camera will take 3½ minutes -- about 7 minutes for both. The satellite will be within transmission range of ground stations up to 12 minutes. This means that the satellite can transmit directly up to 4 minutes of photo data collected while within range of the acquisition station. Connected to each photo system is a 2-watt FM transmitter operating at a nominal frequency of 235.00 mc which will relay picture information on command to ground stations.

At the ground stations, pictures will be displayed on Kinescopes for immediate viewing and photographing. Photo data will also be sent to the U. S. Naval Photographic Interpretation Center for developing and processsing.

How will meteorologists identify photographs transmitted from the satellite? Based on tracking reports, the satellite's orbit will be accurately computed. Scientists connected with the project will be able to determine exactly where TIROS was or compute where it will be at any given time. Not only will the meteorologist know the geographical source of the photo, but he will know the directional orientation of the picture. Around the payload are nine solar cells. They measure the position of the satellite with respect to the sun. This information is transmitted to the ground stations with the TV transmission where it is processed by a computer to show which direction is north in each picture.

Two beacon transmitters, operating on 108.00 mc and 108.03 mc, both with a power output of 30 mw, will be used for tracking purposes. They can be modulated to provide information on satellite attitude, environmental conditions, and satellite equipment operation. For back-up purposes, both frequencies carry the same data. Each of the photo data acquisition stations are equipped with tracking antennas.

When the payload is separated from the third stage of the Thor-Able rocket, it will be spinning at about 136 rpm. Pictures taken from a vehicle with this rate of spin would be blurred. About 10 minutes after payload separation a de-spin mechanism will slow the revolutions to within camera operating limits -- 12 rpm. The de-spin mechanism consists of two weights attached to cables wound around the satellite. As the weights unwind they slow the rate of spin. They drop off automatically.

The satellite is expected to remain stable in its orbit as long as it maintains a minimum spin rate of 9 rpm. When spin slows to the minimum, control rockets will speed the satellite's rotation back to 12 rpm. There are three pair of these jets located around the baseplate of the TIROS. Each set can be used once. It is estimated that spin-up will be necessary only every 20 days. These jets are activated by command from the ground.

An infra-red detector within the payload senses the crossing of the Earth's horizon. This is transmitted to ground stations for processing to determine the attitude in space of the satellite's spin axis; it also can be used as a basis for computing spin rate.

Since TIROS is spin stabilized, it will not be "looking" at the Earth at all times. Based on tracking information, Ft. Monmouth and Kaena Point will program the cameras to take photographs only at those times when the satellite is viewing the Earth and when the area to be photographed is in sunlight. This is done by setting a timer. Program commands can be given as much as five hours in advance. Pictures taken while TIROS is out of range of the ground stations will be stored on tape for later relay. In the remote mode, the timer starts the camera, power, and transmitter functions. Each read-out wipes the tape clean. It immediately rewinds for its next recording.

When the satellite is within range of a station, ground command can directly turn on the cameras and photographs taken above the station will be relayed immediately below, by-passing the magnetic tape.

Ft. Monmouth will be the first to program the TV cameras. This will be done when TIROS sweeps over the East Coast of the U. S. for the first time, about an hour and one-half after launch. The New Jersey station will also read-out the first data after TIROS completes its second orbit, about three hours after launch.

The TIROS satellite is expected to operate for about three months. If its usefulness ends before this time, the tracking beacons can be commanded off.

Officials concerned with the development of the TIROS include:

Dr. Abe Silverstein, Director of Space Flight Programs, and Dr. Morris Tepper, Chief of Meteorological Satellite Programs, both from NASA headquarters; and William G. Stroud, Head of the Meteorology Branch of NASA's Goddard Space Flight Center and TIROS Project Manager.

Herb Butler, project manager for the U. S. Army Signal Research and Development Laboratory.

Vernon Landon and Edwin Goldberg, project managers for the Astro-Electronic Products Division of RCA.